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AUTHOR Williams, Michael D.
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ABSTRACT

The effectiveness of providing a specific kind of motivational feedback was investigated in a computer-based instruction (CBI) environment for different kinds of students and different levels of instructional control. Feedback was intended to affect students' temporal perceptions of the causes of learning successes and failures, their attributions of performance outcomes. Subjects from nine high school economics classes (64 males and 78 females) studied a computer lesson in economics and completed pretests and posttests or an attributional style questionnaire. The study used a randomized block factorial design with attributional feedback and source of control as treatment factors and the multiple-choice posttest and the recall posttest as dependent variables. Six attributional style variables were used as blocking factors. There were no overall advantages for any version of the main experimental treatments. Versions of source of control (program and learner) and attributional feedback (with and without) were not found to differ in their effects on both types of posttest. Results support the fact that learner control is differentially successful for learners with different motivation levels. Learner control can help some students with dysfunctional motivation patterns improve their learning. Findings also support the inclusion of attributions as a variable from which to adapt instruction. Five tables and seven figures present study findings. (Contains 66 references.) (SLD)

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ED 363 271

Interactions among Attributional Style, Attributional Feedback, and Learner-Controlled CBI

by

Michael D. Williams

University of Minnesota

Paper presented at the annual meetings of the

American Educational Research Association

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Interactions among Attributional Style, Attributional Feedback, and Learner-Controlled CBI

Purpose of the study

The purpose of the present study is to investigate within a computer-based learning environment the effectiveness of providing a specific kind of motivational feedback to different types of students and within different levels of instructional control. The type of feedback employed in the study is intended to affect a student's temporal perceptions of the causes of their learning successes and failures, that is their *attributions* of their performance outcomes, an important variable related to a student's motivation to learn. The effectiveness of this feedback is expected to depend on whether the learner has been given some control over the performance situations they experience during the lesson. In addition, these feedback and control conditions are expected to interact with the student's general attributional tendency or style.

Overview of learner-control in CBI

A supposed advantage of computer-based instruction (CBI) over more traditional forms of instruction is its capability to deliver to students "individualized" lessons. That is, the computer can assemble and present to different students tailored lessons with wide variations in sequence of information, amounts of examples and practice questions, or kinds of feedback and review, to name just a few possibilities. Alternatively, the computer may abrogate such decisions and allow the learner to select the instruction they are to receive. Here, the learner operates to control the "flow" or "path" of instructional materials.

Several researchers have proposed lists of computer-based instructional activities which they say could or should fall under the heading of "learner-controlled." Steinberg (1984), for example, lists a range of these events which might be offered within a learner-controlled lesson: which topics to study and in what order; number of exercises to practice and their level of difficulty; presentation of review or supplementary materials; the option not to answer questions. Other activities, too, could be made optional: amount or kind of feedback to see following practice questions; whether to exit the instruction; mode of presentation (e.g. verbal or graphic); and even the option whether to allow further learner-control at all.

The question naturally arises, which is best, program-control or learner-control? That is, who should be the source of such instructional decisions, the learner or the computer? The lesson designer could certainly build in presentation rules in the computer program ("program-control"); alternatively, such control could be relinquished to the learner ("learner-control").

Research tells us that adults in particular prefer a high degree of control over their learning (Penland, 1979). Additionally, several instructional design theorists incorporate learner-control as a major component of instruction (Merrill, 1983, 1987; Reigeluth & Stein, 1983). And, as the use of newer technologies for instruction increases, the capacity to provide learner-control in innovative ways will similarly increase.

After reviewing related research findings, however, it is difficult to evangelize about the unqualified merits of applying learner-controlled instructional activities. The evidence does not support a consistent advantage in learning for those students given instructional options over those not given such choices (Carrier, 1984; Hannafin, 1984; Milheim & Martin, 1991; Steinberg, 1977, 1989).

In fact, providing options to learners occasionally results in negative effects, for example, for those learners of low abilities. Snow (1980), for example, suggests that learners of high ability might be able to use the control they are given to a greater advantage than if they were required to proceed through mandated instructional activities. That is, one or more factors linked with high ability (such as a refined cognitive self-monitoring capacity, or the ability to bring to bear appropriate study strategies, or perhaps

a greater repertoire of metacognitive functions) enables those students to take full advantage of the control they are given over their own instructional activities. Those students of lower ability, however, may actually be hurt by such free control, making inappropriate decisions and learning less than if they were given prescribed instruction; i.e., the rich would get richer.

Some learners respond with negative *affect*, as well, to instruction in which they are given many choices. For example, learners who don't really know why to make certain choices, or who lack the necessary confidence in their decisions feel they are adrift and floundering in a sea of choices. This uncertainty, particularly coupled with high performance expectations, could lead to feelings of confusion or frustration. These learners do not always make the best use of the control given to them during instruction to enhance their own learning and often walk away with feelings of resentment (Keller, 1987a).

Both children and adult learners, it seems, do not unconditionally make the best use of their choices during instruction. The proper design and implementation of such instruction will therefore require designers to more fully understand when and how learner-control can be successfully employed in instruction.

To investigate the effectiveness of learner-control in instruction researchers have typically compared broadly defined "learner-controlled" instructional treatments with "program-controlled" versions (e.g. Hurlock, Lahey, & McCann, 1974). But most lessons are composed of a wide assortment of more specific "instructional events," many subsets of which might be adapted for learner-control (e.g. topic sequencing, number of practice items, optional review; Steinberg, 1984).

In light of this instructional variety, design theories responding with only a blanket "thumbs-up" or "thumbs-down" to the question of a learner-control method would seem to be incomplete. It is necessary to consider learner-control of specific instructional events and activities.

Additionally, because of the largely "uncontrollable" nature (from the designer's point of view) of instruction where decisions are left to the student, one might expect individual learner differences to exert a considerable influence on learning under such conditions (Snow, 1980). That is, as was mentioned earlier, a learning environment which allows learners to control instruction might possibly produce stronger relationships between individual differences and learning to the degree that these individual differences are free to operate than would "fixed" instruction.

Indeed, there is also a large body of research suggesting that a number of individual learner differences can contribute a great deal to both the choices students make and to the effectiveness of those choices. Some researchers (e.g. Carrier & Williams, 1988; Ross & Rakow, 1981; Snow, 1979; Tobias, 1987) examine those differences operating on a global level, interacting with such broad instructional variables as "learner-control" versus "program-control," following an aptitude-treatment interaction paradigm (ATI; see Cronbach & Snow, 1977). Other investigators, however, look for interactions occurring on a moment-by-moment basis under micro-instructional conditions, that is, the task-specific situations encountered during the course of the lesson delivery (e.g. Fisher, Blackwell, Garcia, & Greene, 1975; Johansen & Tennyson, 1983; Seidel, Wagner, Rosenblatt, Hillelsohn, & Stelzer, 1975).

Given these two paradigms, designers are thus faced with questions not only about instructional activities ("Should I offer any learner-controlled activities at all?" "If so, for which instructional events?"), but also about the individual learners ("Do some students generally perform better/worse under learner-control?" "Does the effectiveness of learner-control change for a given student during the course of instruction?").

The usual notion of "adaptive" instruction is that instruction should be adjusted somehow to meet the individual needs of the learners. Both the global ATI paradigm and the microadaptive approach assume the student is "stable" and that it is the instruction which should be tailored to produce optimal

results. However, there is another strategy which is also promising in the case of learner-controlled instruction. That is, instruction might attempt to adjust certain characteristics of the students in order to yield a more optimal match between learner and instruction. This could mean, for instance, in addition to an instructional program adjusting kinds and amounts of options situations given to the learner, instruction might endeavor to intentionally influence students to make certain "optimal" choices or to increase a student's momentary effort expenditure.

There are many factors which could conceivably affect a student's effort and choices during instruction to to impact their ultimate learning. This paper presents a model for the general conditions which contribute to the success or failure of learner-controlled instruction. In this model, a student's responses, choices, and momentary effort expenditures during a lesson in which they have choices to make are conceived of both as dependent variables, influenced by the student's initial cognitive characteristics and motivational tendencies, and as independent variables, having a direct impact on ultimate learning.

Of the kinds of variables listed in the model, those related to motivation are judged here to be central to our understanding of the operation and effectiveness of learner-control in instruction. Indeed, the current study is an extension of the paradigm offered by Carrier and Williams (1988) which found initial student motivation levels predicting both the on-task activities of the learner and the ultimate learning.

The point of view of many investigators of motivation (e.g. Brophy, 1983; Keller, 1987a, 1987b) is that motivation and desire to learn is not something which exists only in specific instructional situations. Rather, it accumulates over repeated exposures to instructional situations, forming a general motivation to learn quite independent of the specific training topic or situation. Students who are used to experiencing failure in their educational experiences will naturally not want to experience similar situations in the future. After some length of time, certain motivational patterns become dysfunctional and resistant to long-term change.

The current study applies the extended ATI paradigm mentioned earlier in an attempt not just to adapt instruction to individual differences in motivational patterns among learners, but to modify those individual differences, at least for the duration of the lesson. The idea is to attempt to short-circuit the dysfunctional motivational patterns, even if temporarily, and increase effortful or motivated student behavior. That is, even if such interventions as are used in this study seldom by themselves improve the long-term motivation levels of students, it might at least attempt to alter them in the short-haul.

Current study

Because of the range of instructional events available to be placed under the learner's management and the wide variety of individual differences likely to interact with these instructional events, the current study is obliged to limit the scope of the investigation to only a few of the potentially relevant variables:

Source of Instructional Control. First, questions related to Source of Instructional Control are addressed by creating versions of a lesson which either give a student the option of retaking practice questions which were incorrectly answered during the lesson (*Learner Control*), or mandating the student to retry the question (*Program Control*). That is, in this way, the amount of instructional material the student sees, a variable shown to have confounding effects in some learner-control studies (Ross & Rakow, 1981; Tennyson & Buttrey, 1980) is held constant. No student is denied presentation of instructional screen; rather the students within a learner-control group have the option of re-viewing a practice question. Due to this relatively small difference between program- and learner- controlled treatments, it is not expected that their will be any overall superiority for either one of the groups.

Attributional Style. Second, the motivational trait variable of Attributional Style is included as being especially relevant a learner characteristic for the effectiveness of offering students the options

mentioned above. An "attribution" refers to an individual's perceived causes of their own successes or failures. Kukla (1978) and Weiner (1974) explain that the degree to which a person ascribes the causes of their own successes or failures to ability, effort, task difficulty, or luck will differentially predict whether or what kinds of subsequent performance situations the student is likely to choose when given the opportunity.

These four variables of attributions, ability, effort, task difficulty, and luck,can be grouped along two primary dimensions: internal versus external; and stable versus unstable. The internal attributions are ability and effort, and represent performance attributions due to perceived personal (self) characteristics. The external attributions of task difficulty and luck represent causes of success or failure due to the environment or circumstances outside the student. [Note: even though this conception of attributions uses the terms "internal" and "external" to describe the source of perceived causation, these are not the same dimensions delineated by Rotter (1966) in his more familiar "locus-of-control" construct. What is often overlooked by some researchers using Rotter's scheme is that he originally intended it to refer only to locus-of-control *of reinforcement*, that is, what is the perceived source of reward, incentive, and other reinforcements, not, as in attribution theory, to the source of causation of events.]

The stable variables are ability and task difficulty, and are perceived by the student to be fairly fixed causes of success and failure. Effort and luck are unstable in that they are perceived to possibly vary or fluctuate with each success or failure.

It is argued that these variables are useful to include in the current study because they attempt to explain the student's on-task motivation through their perceptions about the causes of a successful or failed performance task. Because the instructional events subject to learner- or program-control in this study are performance related, that is, practice question retries, it is expected that individual differences in attributional style will interact with *Source of Instructional Control,* either program- or learner-controlled.

Dweck and Leggett (1988) point out that certain motivational patterns are "maladaptive" and lead to poor performance. The attribution theory literature presents certain styles which are predicted to be "adaptive" and functional, namely students who tend to attribute their successes to the internal causes of ability and effort, and those who attribute their failures to lack of effort. Other styles will show themselves to be dysfunctional, namely, students who tend to attribute their successes to external causes, and those who attribute their failures to lack of ability.

Attributional Feedback. Third, there are questions of whether students' choices and/or on-task effort can be influenced by instructional manipulations. Since some Attributional Styles are related to patterns of motivated (or unmotivated) behavior, the question arises whether such dysfunctional motivational attitudes can be altered, at least for the duration of a lesson. Several studies have shown that such harmful attributional styles can be "retrained" (Andrews & Debus, 1978; Dweck, 1975; Fowler & Peterson, 1981; Medway & Venino, 1982; Schunk, 1990a). In these approaches students are given attributionally related feedback following their performance successes or failures in an attempt to create more efficacious behavior patterns and on-task effort, such as more practices selected again following incorrect first tries. The current study seeks to investigate whether such strategies can be applied within a computer-based instructional environment.

Summary

The specific research questions addressed in the present study are summarized as follows:

1. Do students with differing levels of various Attributional Styles show poorer on-task motivation and thence, poorer learning?

2. Do different levels of the various Attributional Styles interact with a learner- or program-controlled instructional condition to produce differential learning effects? If so, which of the Attributional Styles seems to be the most involved in the interaction?

3. Do different levels of the various Attributional Styles interact with the attributional feedback conditions to produce differential learning effects? Here also, if so, which of the Attributional Styles seems to be the most involved in the interaction?

Methods

Subjects

Subjects were drawn from a pool of available students in economic classes at three high schools in San Diego County, California. The teachers who volunteered their classes were solicited for their participation at a conference of economics educators in San Diego County.

Classes were standard high school economics required of all students by the state of California, and were composed entirely of seniors. School #1 had four available economics classes (*n*'s= 20, 20, 15 & 19; total *n*=74), two classes each taught by two teachers. School #2 had students available from two classes (*n*'s= 19 & 21; total *n*=40) both taught by the same teacher. School #3 had students available from three classes (*n*'s= 23, 28 & 17; total *n*=68) all taught by one teacher. The available subject pool size across all classes was 182 students.

All students were volunteers in the study, and no pressure (e.g. grades) was used to obtain their participation. Other than those students who had conflicting activities (such as sports events), all available students participated in the study.

Because the class is required of all seniors for high school graduation, the students were typical of all seniors in their schools; that is, they had a heterogeneous mix of abilities, ethnic groups, and socioeconomic strata. None of the classes were "tracked" by ability grouping. Nevertheless, the teachers did identify nine students (including four Asian immigrants) who had clear English deficiencies. These students were allowed to participate in the lesson, but were excluded from data analysis.

Additionally, due to various random but typical circumstances found while conducting field studies in schools (e.g., illnesses, absences due to sports events, equipment malfunctions, abbreviated class time due to assemblies) 31 students were unable to finish all portions of the study (computer lesson, pretest, posttests, or attributional style instrument) with complete data. This left a final sample *N* of 142, of which 64 were males and 78 were females. A cursory check of data comparing those students excluded with those included in the data analysis finds practically identical mean scores on all variables measured in the study. This supports the presumption that missing data occurred randomly in the study, and was likely not due to some undetected underlying bias.

Lesson Materials

Content Selection All students participated in a concept lesson from macroeconomics on "Unemployment." In general, the lesson was intended to provide students with basic terminology and concepts within the broader concept of "Unemployment." Six concepts were covered: *The Workforce, Social Costs of Unemployment, The Unemployment Rate, Full Employment, Types of Unemployment,* and *Cyclical Unemployment*.

The curricular sequence for each of the economic courses varied somewhat across the teachers, but all followed the California Curriculum Framework for economics education recently mandated at the time of the study. All the teachers were pleased with the content of the computer lesson and its placement in their courses. This study, then, gave their students an opportunity to see content not usually sufficiently covered in their economics course, and to experience it through an alternative delivery mode (computer) which according to some writers (e.g., Ehman & Glenn, 1987; Lovell, 1991) is too infrequently employed in economics education.

Content for use in the lesson was gathered and synthesized from a variety of economics textbooks and was intended to fulfill the California Curriculum Framework. Expert review by the faculty director of the Center of Economic Education (CEE) at San Diego State University provided further information for revising the lesson.

Prerequisites The lesson has no prerequisite knowledge in economics other than an elementary exposure to the circular flow of goods, money, and labor. All teachers indicated their students had such an exposure. However, teachers were also quite certain students had not been formally exposed in their classes to the content of the lesson used in the study. Even so, a pretest is given in the current study to account for any prior knowledge of the lesson material.

Instructional Design Gagné, Briggs, and Wager (1988) present an instructional design theory which provides the basis for the design of the lesson which the proper construction of a lesson requires the inclusion and tailoring of nine "instructional events."

The lesson concluded by presenting the student with the results of their final quiz performance, that is, the number correct for the number of questions they saw (maximum six, one for each concept).

Except for the quiz section at the end of the lesson, students were able to move forward to the next screen or concept with the right-arrow key; they could backup through the lesson to review any material by pressing the left-arrow key. The final quiz went back and forth between the menu of concept topics and the specific quiz items. No "backing up" was allowed in this section of the lesson.

Reading Levels Four readability tests were used which are appropriate for analyzing high school level texts. The results of these tests show reading grade levels from 8.0 to 10.6. Clearly, at least on the basis of these tests, the text is appropriate for most high school seniors.

Apparatus

The program was designed to run on all Apple II computers with at least 64k of RAM and one 5–1/4" floppy disk drive. Although lesson screens contained various colors, a color monitor was not necessary in order to use the program effectively. Each school had a different configuration of microcomputers available to the study for lesson delivery. The entire lesson is stored on one 5–1/4" floppy disk formatted in Apple's disk operating system *DOS 3.3*. The computer lesson was programmed by the study's author in Apple's *Applesoft BASIC* language. All information on the screen is displayed in Apple's high resolution graphics mode.

Instruments

Attributional Style Attributional style has typically been measured in several ways with no agreement about a "best" way (Stipek & Weisz, 1981). Of common approaches, those which use structured unipolar ratings (e.g., "For each of the following factors, rate from 1 to 5 the extent that it caused your success (failure) on the task.") have been found to be easy and valid (Elig & Frieze, 1979; Maruyama, 1982). Additionally, attributions have been found to be fairly stable over a variety of performance conditions (Bar-Tal, Raviv, Raviv, & Bar-Tal, 1982) so attributions will only be measured prior to instruction.

The measure of attributional style used in this study is adapted from the *Sydney Attribution Scale* (*SAS*) found in Marsh (1983), further discussed in Marsh (1984). The purpose of the instrument is to measure students' perceptions of causes of their academic success and failure. The version of the instrument used in this study is designed to measure six scales which result from the combination of outcome (Success or Failure) and perceived cause (Ability, Effort or External Causes). Even though much of the literature talks about different kinds of external attributions (luck, task difficulty, etc.), Marsh (1983, 1984) collapsed them together under a single External scale type. Since the particular type of external cause is not germane here, Marsh's approach is also adopted for the current study. The resulting six attributional style scales thus are labeled *Success due to Ability*, *Success due to Effort*, *Success due to External Causes*, *Failure due to Lack of Ability*, *Failure due to Lack of Effort*, *Failure due to External Causes*. Individual differences in these six Attributional Style scales are expected in the current study to have direct effects on learning. This would support findings from other researchers (Bar-Tal, 1978; Dweck & Leggett, 1988; Stipek & Weisz, 1981) which show some of these variables as dysfunctional and associated with poor on-task motivational behaviors.

Marsh's (1983, 1984) instrument contained 72 questions covering two subject areas (mathematics and reading). Marsh et al. (1984) report coefficient α reliabilities for the six scales as ranging from .66 to .90. The current study deals with only one subject (social studies), so the scenarios were rewritten and the number of questions was reduced by half to 36. (The effect of halving the number of items in the original scales on reliability can be estimated using the Spearman-Brown prophecy formula [Lord & Novick, 1968]. The resulting projected coefficients α range from .81 for the *Success due to Ability* scale to .49 for the *Failure due to External Causes* scale. The effect on reliability of wording changes is unknown.) The revised instrument henceforth is referred to as the *Attributional Style Questionnaire* or *ASQ*.

Each of the six scales in the *ASQ* is assessed with six structured unipolar rating scales. The instrument consists of 12 brief scenarios, each with three rating scales, in which the student is to suppose himself or herself in a situation representing academic success or failure in social studies. Eight of the scenarios in the *ASQ* relate to the social studies generally; four relate specifically to economics. Marsh et al. (1984) found that assessments of attributional style are more valid when they are task-specific rather than abstract or too general. Therefore, the current instrument presented scenarios of a variety of real and common performance situations in the social studies in which the students might find themselves, such as quizzes, oral reports, research papers. Half the scenarios pose failure situations, half pose success situations. With each scenario are three randomly ordered, plausible causes for the success or failure outcome, one each for Ability, Effort, and External Causes. Students make independent ratings of each cause along a 5-point response scale from *false*(1) to *true*(5).

The following is a sample failure scenario with its three attribution rating scales. The first rating item (item 7a.) is an example of *Failure due to Lack of Ability*, the second item represents *Failure due to Lack of Effort*, the last is *Failure due to External Causes*:

Sample Item:

		False	Mostly False	Sometimes True Sometimes False	Mostly True	True
7.	Suppose you got poor marks for a report you gave to class on a business project you observed. This was probably because . . .					
	a. you have trouble giving any kind of speech	☐	☐	☐	☐	☐
	b. you really didn't try very hard to do well	☐	☐	☐	☐	☐
	c. the project you observed was boring	☐	☐	☐	☐	☐

Since "*Attributional Style Questionnaire*" is too arcane a term for students to understand, the students' copy of the instrument is relabeled "Social Studies Opinions Questionnaire," a phrase somewhat more meaningful to them. The introductory section of the questionnaire was designed to orient the students to how to complete the form. Throughout the questionnaire are statements intended to assure the student that this is not a test, that everybody feels differently about the scenarios, and that there are no right answers. The first page contains two sample scenarios, each with three already completed rating items from hypothetical students named Terry and Chris. Following each scenario are explanations for why Terry and Chris answered as they did. The second page also contained two sample scenarios. This time, however, students must answer for themselves. Following completion of these two scenarios, students completed the final 12 scenarios, those used in data analysis. The sample questions in the introduction section of the instrument were slightly modified to "Americanize" it a bit from Marsh's (1983) version (the original *Sydney Attribution Scale* contained some Australian idioms).

Posttests and Pretest Two posttests were designed to measure comprehension in the "defined concept" domain (Gagné, 1985). That is, the tests were constructed to 1) tap each learner's ability to both retrieve definitional information about the given concept, and 2) to classify or discriminate instances from non-instances of the concept. The tests assessed learning of the most important material in each concept unit.

The *Multiple-Choice Posttest* is a paper-and-pencil test composed of six multiple-choice items (four distractors), one for each of the concepts taught in the lesson. (The posttest was not computer-delivered in order to cut down on computer-lab time and therefore to be able to rotate more students through the computers in a shorter period of time.) This type of item measures the student's capacity to sort through several similar and plausible answers and discriminate the correct answer from among them. Both question stems and distractors were constructed with paraphrased material from the lesson, and were designed to avoid the simple recognition of verbatim (episodic) information, and instead tap semantic comprehension (Anderson, 1972).

The *Recall Posttest* is also a paper-and-pencil test composed of six items. Here, however, the items are free recall, or fill-in-the-blank questions. Students were only required to write a one or two word answer. (This offers another reason why the test was not computer-delivered. Asking students to record their *Recall* answers into the computer would introduce the confounding variables of typing speed and accuracy.) Blanks or partial answers were counted as incorrect.

The *Multiple-Choice Pretest* was identical to the *Multiple-Choice Posttest*. A *Recall Pretest* was tried out on a few students during the Pilot Study, but all students gave up without completing a single answer. Therefore, no *Recall Pretest* was included in the study.

Content validity of achievement tests is defined as the faithfulness and representativeness with which a test samples from the content domain. In this case, the content domain is restricted to the material presented in the lesson, namely the six concepts chosen for inclusion in the "Unemployment" lesson. The content validity of the tests was assessed informally by three of the teachers involved with the study and the faculty director of the Center of Economic Education (CEE) at San Diego State University. The CEE director said the tests were adequate, if somewhat short. The teachers also agreed it was an adequate test of the content of the computer lesson, but expressed the opinion that a longer test might create feelings of frustration or fatigue in some students, especially occurring on the heels of the pretest, the *Attributional Style Questionnaire*, and the computer lesson.

Dependent Variables

This study has two dependent variables, scores on the *Multiple-Choice Posttest* and the *Recall Posttest*, given approximately one or two weeks following administration of the computer lesson. The logistics of the study did not permit a delayed posttest. Both posttests have a minimum possible score of 0 and a maximum possible score of 6. Posttest scores are transformed to z-scores prior to analysis.

Independent Variables

Treatment Factor: Attributional Feedback The *Attributional Feedback* treatment has two levels: "Without Attributional Feedback" and "With Attributional Feedback." In the With Attributional Feedback group the computer provides attributionally related evaluative comments to the student after each performance outcome. The Without Attributional Feedback group received only neutral comments ("Let's try that question again." or "Let's move on...").

Feedback for the With Attributional Feedback group is provided only at performance related events (practice, feedback, etc.). The feedback statements are composed of a variety of comments to the student meant to directly influence the momentary motivation levels with both forward-looking perceptions of self-competence, expectancies of success, and self-efficacy, and with backward-looking comments to the student reflecting a temporary kind of attribution retraining (Schunk, 1982, 1983). These statements to the student are not meant to provide informational or strategically related "advisements" (e.g., Johansen & Tennyson, 1983; Tennyson, 1981), or informational or elaborative feedback (e.g., Sales & Williams, 1988).

This treatment is an operationalization of a specific type of motivational intervention in the areas of attributions, self-efficacy, and locus of causality. Following each performance situation and subsequent informational feedback during the lesson, students in the With Attributional Feedback group received a statement of attributional interpretation on their performance. The idea is to encourage attributions of performance which are seen as functional and beneficial to learning, namely to ascribe initially successful performance to ability, successful performance after initial failure to ability or effort, and repeated failed performance to lack of effort or to external factors.

Weiner (1983) points out that the most valid types of attributional feedbacks are those interpretations which are consistent with the actual circumstances surrounding the performance. That is, students tend to discount attributional feedback if they perceive it to be gratuitous, irrelevant or unconnected to their actual success or failure. In the current study different types of feedbacks were written to match the particular circumstances of each student's performance. So, for students in the With Attributional Feedback treatment condition, correct answers on the first try of a practice question prompted the computer to produce statements which interpreted the success as due to ability (e.g. "You seem to know this material very well!"). Incorrect answers on the first try produced statements which interpreted the failure as due to lack of effort (e.g. "Perhaps you weren't concentrating enough on the question."). Correct answers on the second try yielded statements intended to encourage the belief that the extra effort paid off, and so interpreted the success as due to effort (e.g. "Terrific! It pays to try a little harder the second time."). Finally, incorrect answers on the second try produced statements which interpreted the failure as due to external causes and not due to lack of effort or lack of ability (e.g. "You

made a good try. That question was especially hard."), as attribution of failure to any internal cause will decrease feelings of self-efficacy and motivation.

Treatment Factor: Source of Control The *Source of Control* treatment also has two levels: "Program Control" and "Learner Control." In the Learner Control group students are given the option of retrying each incorrect practice question or of simply going on ahead into the next concept. Additionally, during the quiz at the end of the computer lesson, these students are presented with a menu of the six concepts from which they can select a topic on which they wish to be quizzed, or elect to terminate the lesson.

Students in the Program Control group received an automatic second chance after each incorrect practice performance and feedback. Also, Program Control students mandatorily received all six quiz questions at the end of the computer lesson, presented in a random order. The lesson terminated after the conclusion of the sixth quiz question.

The two experimental treatment factors, *Source of Control* and *Attributional Feedback* are crossed in this study to create four treatment cells. The computer lesson was modified to only present to a student the treatments which match a preassigned ID number.

Blocking Factor: Attributional Style Prior to completing the lesson all students were measured on the *Attributional Style Questionnaire*. This instrument yields data for each student on six scales: *Success due to Ability*, *Success due to Effort*, *Success due to External Causes*, *Failure due to Lack of Ability*, *Failure due to Lack of Effort*, *Failure due to External Causes*. The data are continuous with a minimum possible score on each scale of 6 and a maximum of 30, depending on how students rated each item comprising each scale. Each of these scales was transformed and converted into a blocking factor with two levels, Low and High. That is, students were classified as having either Low or High levels of each of the six attributional styles. Thus, an individual student might score Low on attributions of their successes to ability, High on their attributions of success to effort, and so on, for each of the six attributional style blocking factors. Logistics prevented randomly assigning students within each level of all possible combinations of the six blocking factors prior to administration of the computer lesson. Rather, the blocking factors were created just prior to their inclusion in the data analysis.

Covariate: Pretest The *Multiple-Choice Pretest* functioned as a covariate for both posttests.

Study Design

The study employed a randomized block factorial design (Kirk, 1982) with *Attributional Feedback* and *Source of Control* as the two treatment factors, and two dependent variables, the *Multiple-Choice Posttest* and the *Recall Posttest*. The six attributional style variables are transformed and used as blocking factors. The *Multiple-Choice Pretest* is included in the design as a covariate. All treatment and blocking factors are included in the design as fixed factors. The design model used in the analyses is "non-additive" meaning that interaction terms between blocking factors and treatments will be included (Kirk, 1982). The analyses of variance were multivariate in that both dependent variables are analyzed simultaneously.

Because each student has scores on all six of the attributional style blocking factors, six separate multivariate analyses of posttest variance will be produced, each one including a different blocking factor. The danger of inflated Type-I error due to running six separate analyses of variance is minimized due to the fact that the six attributional style scales on which the blocking factors were created were orthogonal, that is, were statistically independent.

The six multivariate analyses of covariance (one analysis for each of the six attributional style blocking factors) will follow procedures set out by Timm (1975) and Bray and Maxwell (1985). That is, significant multivariate effects will be followed up by appropriate follow-up univariate tests (examining each dependent variable by itself). To minimize Type–I errors, post hoc comparisons of all significant

effects in the analysis will use the conservative Roy test (Timm, 1975), a multivariate generalization of the more familiar Scheffé test for univariate contrasts (Kirk, 1982).

Procedures

Pilot Study Forty-four students (24 were male and 20 were female), aged 14 to 19, were recruited from a rather unusual population, the San Diego County Court Schools. These students had no economics background, and comprised an extremely wide range of academic backgrounds and abilities, but still provided useful information for revising the lesson and instruments. As could be expected, students in court schools are generally extremely poorly motivated and have low self-esteem. The teachers try to individualize instruction as much as possible, and were interested in providing their students any excuse for using computers.

Students began by completing the pretest and attributional style instrument according to administration procedures described for the final study. Students were randomly assigned to one of the four treatment cells and completed the lesson at their own pace. In an attempt to gather information to improve the quality of the computer lesson, students were also asked to identify any points in the lesson which appeared confusing. Students were quite forthcoming and produced valuable information used to revise the lesson used in the final study. Students pointed out awkward screen displays, misspelled words, and in two cases programming errors. At the conclusion of the study, students completed the posttests.

Preliminary analysis of pilot study data by treatment groups was reported by Williams (1989). There were no significant differences for either the 'Source of Control' factor, or the 'Attributional Feedback' factor, or their interaction. The sample size was too small to permit any more complicated analysis which would have included attributional style data.

Schedule The final study took place over two months. The study was administered in one school at a time over that period. Three class days were required for each student to complete the study. The administration of the *Attributional Style Questionnaire* and the *Multiple-Choice Pretest* was given first to each economics class as a whole. One week later, the computer lesson was administered in each participating economics class. The lesson was designed to be completed within one 45-minute class period. Because some of the classes had more students than available computers, the experimenter needed to return to those schools the next day to continue the lesson administration to those students who were omitted the previous day. Between two and three weeks after completion of the computer lesson, the *Multiple-Choice* and *Recall Posttests* were administered, again to each economics class as a whole.

Results

All statistical analyses were performed using the *Statistical Package for the Social Sciences (SPSS) 4.0 for the Macintosh*, (© 1990, SPSS Inc.).

The α level chosen for this study to determine statistical significance is set at .05. However, other precautions are taken at various points in the study to guard against an inflated Type–I error rate. First, when inspecting correlation tables, α is lowered to .005. Second, because six separate MANCOVA's will be conducted on the same data set (each including a separate attributional style blocking factor) care was taken to make the attributional scales on which the blocks were based orthogonal (statistically independent). Last, follow-up contrasts to the MANCOVA's employ the conservative Roy test (Timm, 1975), a multivariate generalization of the more familiar Scheffé test for univariate contrasts (Kirk, 1982).

Scale Descriptions and Reliabilities

Each pretest, posttest, and attributional scale used in the study contains six items. For each of the achievement measures, an item was worth one point; therefore, the minimum score for a test is 0 (no questions answered correctly), the maximum is 6 (all questions in the test answered correctly). For each of the attribution scales in the *ASQ*, the student could respond from 1 (*false*) to 5 (*true*); therefore the minimum score on a scale would be 6 (answering *false* on all items), the maximum is 30 (answering *true* on all items in the scale).

Pretest and Posttests Table 1 presents total sample means, standard deviations, and coefficient α reliabilities (Lord & Novick, 1968) for all of the achievement measures. Mean scores on the achievement measures show a clear improvement in scores between *Multiple-Choice Pretest* and *Posttest*, from slightly over half correct (56 percent) on the pretest to almost 5 correct of the maximum 6 items on the posttest (80 percent). This is confirmed with a correlated t-test between the two means, $t(141)=-12.77$, $p<.001$. The pretest score seems somewhat high considering the students were not supposed to know anything about the lesson content prior to the computer lesson. Perhaps it reflects a more general test-taking ability in the students, as well as knowledge about the subject matter. It can also be seen that students averaged about half of the questions correct on the *Recall Posttest.* This is lower than desired, but perhaps reflects that the *Recall Posttest* provides fewer cues for a memory scan than the *Multiple-Choice Posttest*. Additionally, the *Multiple-Choice* items on this test give students the chance either to select the correct answer if they know it, or to rule out known incorrect answers, or to guess. The options for ruling out incorrect answers or guessing on the *Recall Posttest* are more restricted and might be expected to produce lower scores as a result. The standard deviation of the *Recall Posttest* is somewhat greater than the two multiple-choice tests (pre and post), which indicates a greater range of this type of learning, as well.

Table 1
Means, Standard Deviations, and Reliabilities for the Achievement Measures

N=142	Scale Mean	Standard Deviation	Coefficient α
Multiple-Choice Pretest	3.35	1.32	.32
Multiple-Choice Posttest	4.78	1.27	.51
Recall Posttest	2.97	1.70	.64

The reliability coefficients of the achievement measures were quite low. This has several possible interpretations. First, the number of test items in each test might be too small. However, an application of the Spearman-Brown prophecy formula (Lord & Novick, 1968) to these reliabilities shows that even if each test length were doubled with equivalent items to a total of 12 questions, the reliabilities would not increase substantially (a 12-item *Multiple-Choice Pretest* would have a predicted coefficient α of .48; the *Multiple-Choice Posttest* reliability would increase to .68; the *Recall Posttest* reliability would increase to .78).

There is another interpretation for the low reliability coefficients of the achievement tests which is also defensible, and is germane to the study. The test might lack homogeneity, not because of poor item sampling, but because the items intentionally span several content domains. That is, the items were not drawn from the same universe of possible test items (Lord & Novick, 1968; Cronbach, Gleser, Nanda, & Rajaratnam, 1972), but instead from six separate universes, one for each concept presented in the lesson. If this interpretation holds, an index of internal test consistency coefficient α such as used here may not be terribly informative about overall test trustworthiness. That is, if the test content is heterogeneous by design, standard test homogeneity indices should not be expected to be high. Further evidence of this possibility is found in the coefficient α of the *Multiple-Choice Posttest* (.51) which is substantially higher than the *Multiple-Choice Pretest* (.32). The two tests are identical and were administered from

three to four weeks apart. Therefore any changes between the two test reliability coefficients likely reflects changes in the student in the intervening time period. During instruction the six lesson concepts were integrated, thereby, by definition, producing a more homogeneous set of concepts, and thus test items. So rather than reflecting a poor instrument, the low reliability coefficients might also reflect the intended heterogeneity of the test items. It is also worth noting same in addition to the possibility that a low test reliability index does not necessarily indicate a poor test, Wainer (1986) also points out that a high test reliability index does not always indicate a good test.

Attributional Style Scales Table 2 presents total sample means, standard deviations, and coefficient α reliabilities for the six *ASQ* attributional style scales. Mean scores on the scales show that students had a greater tendency to see their attributions of both successful and failed performances as due to *Effort*, and were least likely to ascribe the causes of their successful and failed performances to *External Causes*. The standard deviations were very consistent across the six scales.

Table 2
Means, Standard Deviations, and Reliabilities for the Attributional Style Scales

N=142	Scale Mean	Standard Deviation	Coefficient α
Success due to Ability	21.45	3.71	.72
Success due to Effort	24.57	3.37	.75
Success due to External Causes	16.92	3.39	.61
Failure due to Lack of Ability	16.51	3.64	.58
Failure due to Lack of Effort	20.06	3.49	.64
Failure due to External Causes	15.49	3.30	.62

The reliabilities across all the scales are slightly lower than those reported by Marsh, Cairns, Relich, Barnes, and Debus (1984; Table 3.2 in Chapter 3). Since the formats and the administrations are the same between Marsh et al. (1984) and the current study, these lower reliabilities are likely due to the change of subject matter between Marsh's (1983) instrument (scenarios in mathematics and reading), and the instrument used in the current study (social studies scenarios). Nevertheless, the reliabilities are still respectable for scales containing only six items each.

Scale Intercorrelations

Among Achievement Measures All intercorrelations among the three achievement measures are significantly non-zero at $p<.005$. The *Multiple-Choice Posttest* shares 22 percent ($r=.47$) of its variance with both the *Multiple-Choice Pretest* and the *Recall Posttest*, and the *Multiple-Choice Posttest* overlaps about 6 percent ($r=.25$) with the *Recall Posttest*. That the pretest is significantly related to both the posttests provides justification for including the pretest as a covariate in subsequent analyses of variance.

Among Attribution Scales Table 3 presents correlations among the six *ASQ* attributional style scales. Because the number of correlations reported tends to inflate the Type–I error rate, correlations are reported to be significant only if $p<.005$. There is a substantial positive correlation between the *Success due to Ability* scale and the *Success due to Effort* scale ($r^2=.22$), indicating a substantial degree of commonality between the scales. There is also a substantial positive correlation between the *External Causes* scales for both *Success* and *Failure* ($r^2=.18$). This indicates that a student's level of attribution of their performance to *External Causes* was fairly consistent regardless of whether the performance a successful one or a failed one. In other words, there is some evidence that a general *External Causes* attributional style construct is at work. Finally, there is also a positive correlation between *Success due to External Causes* and *Failure due to Lack of Ability* scales ($r^2=.10$). That is, if a student tended to ascribe their successful performances to external reasons, they would also tend to attribute their failures to a lack of their own ability. This is consistent with research on dysfunctional attributional styles (e.g.,

Dweck & Leggett, 1988). Students exhibiting such an attributional style pattern generally lack internal motivation and self-esteem. They are willing to label their own successes as not being due to their own skill, but rather due to outside circumstances. But they also tend to take the blame themselves for their own failures.

Table 3
Pearson Correlations among
Attributional Style Scales

	Success due to:			*Failure due to:*		
N= 142	*Ability*	*Effort*	*External Causes*	*Lack of Ability*	*Lack of Effort*	*External Causes*
Success/ Ability	.–					
Success/ Effort	.47*	.–				
Success/ External Causes	.09	-.14	.–			
Failure/ Lack of Ability	-.19	.10	.32*	.–		
Failure/ Lack of Effort	.15	.23	-.01	.12	.–	
Failure/ External Causes	.08	-.06	.43*	.14	-.07	.–

(* significant at $p<.005$)

Between Achievement Measures and Attributional Style Scales Finally, Table 4 presents correlations between the three achievement measures and the six *ASQ* attributional style scales. Again, because the number of correlations reported tends to inflate the Type–I error rate, correlations are reported to be significant only if $p<.005$. The only significant correlation is a negative one between the *Recall Posttest* and the *Failure due to Lack of Ability* attributional scale ($r^2=.10$). This partially confirms what was suggested in Table 3 that students who tend to attribute their own failures to *Lack of Ability* exhibit a dysfunctional motivational pattern which is often associated with poor performance. They blame their poor performance on their own ineptness rather than on not trying hard enough.

Table 4
Pearson Correlations between
Achievement Measures and Attributional Style Scales

	Success due to:			*Failure due to:*		
N= 142	*Ability*	*Effort*	*External Causes*	*Lack of Ability*	*Lack of Effort*	*External Causes*
Multiple-Choice Pretest	.03	.02	.04	–.12	–.09	.13
Multiple-Choice Posttest	.08	–.01	–.14	–.17	.00	.05
Recall Posttest	.15	–.23	–.10	–.32**	–.03	.07

(* significant at $p<.005$)

Data Transformations

Attributional Style Scales A principal components factor analysis (Rummel, 1970) was conducted on the six scales which comprise the *Attributional Style Questionnaire*. The intention of the analysis was to reduce any multicollinearity among the scales, while still preserving the six attributional style constructs. To do this, the analysis was forced to produce all six possible components regardless of the magnitude of their eigenvalues.

The resulting six factor components were subjected to an orthogonal varimax rotation (to maximize the discrimination between factors; see Rummel, 1970). Table 5 presents the rotated factor loadings. Each factor has one loading greater than .95, coinciding with a different original scale. The loadings of each factor are very distinct and clearly represent only one of the six original scales. However, unlike the original *ASQ* scales, the new factors are now orthogonal.

Table 5
Factor Analysis of the Six Attributional Style Scales:
Loadings for the Rotated Factor Matrix

	Factor #					
	1	2	3	4	5	6
Success due to Ability	.043	-.118	.070	.955	.250	.064
Success due to Effort	-.028	.071	.113	.250	.955	-.085
Success due to External Causes	.221	.169	-.005	.063	-.084	.955
Failure due to Lack of Ability	.061	.974	.066	-.111	.066	.159
Failure due to Lack of Effort	-.037	.063	.990	.065	.103	-.005
Failure due to External Causes	.974	.060	-.038	.040	-.025	.208

Factor scale scores were computed for each student using the factor loadings from each factor above to produce weighted combinations of the original scales. Each scale is standardized to have a mean of 0 and a standard deviation of 1. The subsequent labels of these derived scales reflect the predominant loading in the factor from the original set of scales.

Lastly, to create the attributional style blocking factors, each of the six derived scale distributions was divided at its median into two parts, Low and High, reflecting relatively low and high degrees of attributions of successful or failed performance to ability, effort, or external causes. These Low and High groups for each attribution factor scale were subsequently used as the two levels of the attributional style blocking factors included in the analyses of variance of posttest scores.

Pretest and Posttests To ensure that the dependent variables and covariates are drawn from normally distributed populations in this sample, the raw scores of the three achievement measures were transformed in to z-scores (mean=0, standard deviation=1) . This also aids the interpretation of results: cell values are given in terms of standard deviation units above or below the grand mean.

Multivariate Analyses of Covariance

Tests of hypotheses of treatment differences, block effects, and their interaction are conducted using multivariate analyses of covariance. The model designates both treatments and blocks as fixed effects, and includes all possible interaction terms among treatments and blocks. Six analysis are presented, each including a different attributional style blocking factor. Both posttests were included and were analyzed simultaneously in the MANCOVA's. The pretest was included as a covariate in each analysis.

These tests are performed simultaneously on both posttests after removing any covarying effects of the pretest. Thus, all tests of significance are on adjusted posttest scores, that is posttests scores controlling for any initial pretest effects. Follow-up contrasts of all significant multivariate effects tested employed Roy's test (Timm, 1975), a conservative multivariate analog to the univariate Scheffé test.

Pretest Effects The *Multiple-Choice Pretest* was found to have a significant effect in all six of the MANCOVA's. The size of the effect ranged from a Wilk's λ of .770 (F=19.65, p<.001) in the MANCOVA of *Failure due to External Causes*, to a λ of .800 (F=16.54, p<.001) for the *Failure due to Lack of Ability* MANCOVA. In follow-up univariate analyses, the *Multiple-Choice Pretest* was

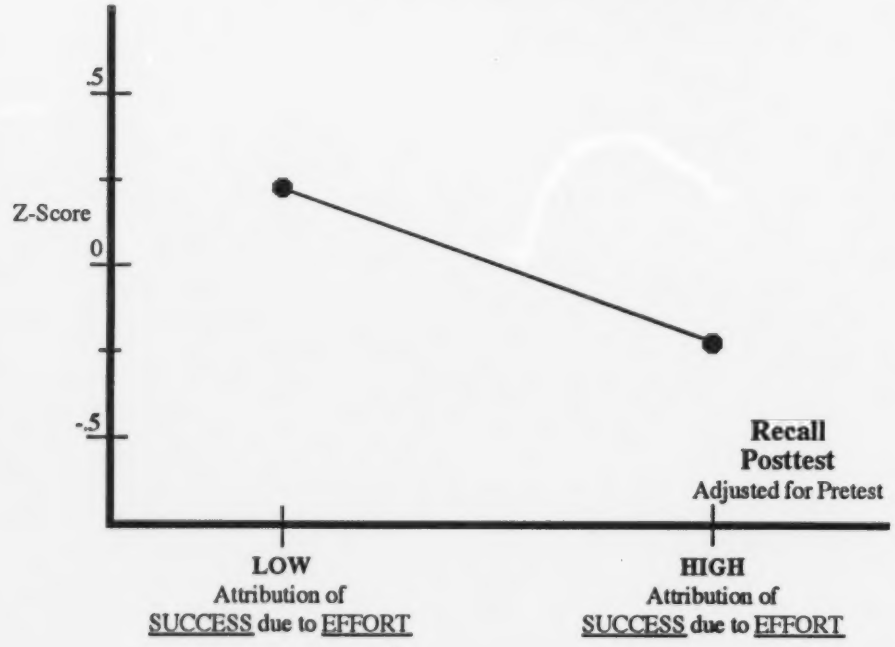
significantly related to both posttests in all MANCOVA's. No significant interaction was found between *Pretest* and any other term in the ANOVA model.

Treatment Main Effects None of the experimental treatments (*Source of Control* or *Attributional Feedback*) had any significant effects by themselves on the posttests for any of the six MANCOVA's.

For Blocking Factor=*Success due to Ability*. No significant main effects or treatment interaction effects were found for this blocking factor.

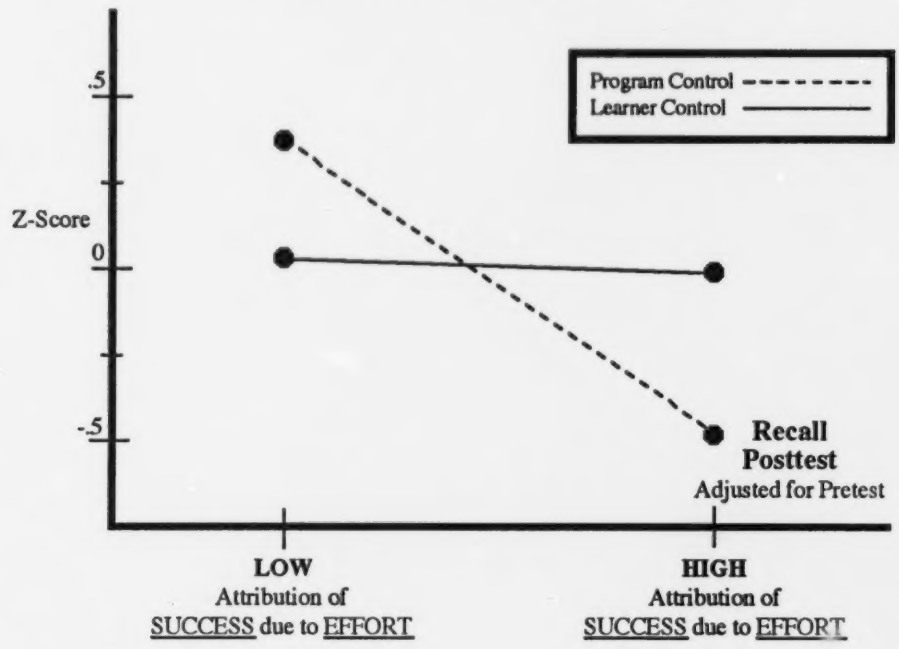
For Blocking Factor=*Success due to Effort*. Two significant effects were found for this blocking factor. The first is the *Success due to Effort* blocking factor alone (Wilk's λ=.938, F=4.36, p=.02). The follow-up univariate test finds that the Low *Success due to Effort* blocks had significantly better adjusted *Recall Posttest* scores than the High block $t(133)$=2.95, p=.003. That is, students who tend to attribute their successes to their own effort perform the worst. (Conversely, students who tend not to attribute their successes to their own effort perform the best.) Figure 1 illustrates this blocking factor effect.

Figure 1
Means for *Success due to Effort* Blocks



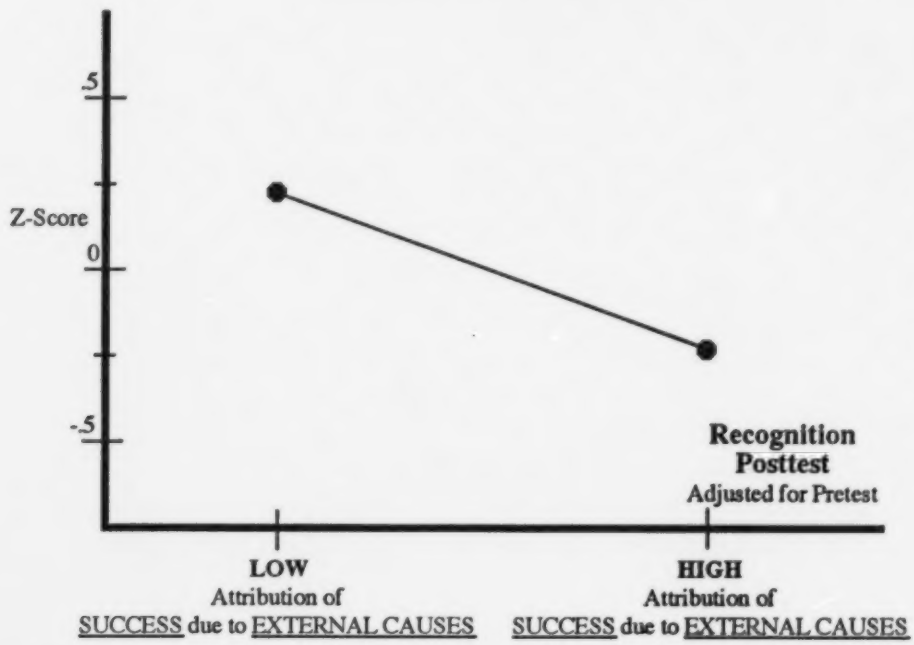
This main block effect is conditioned somewhat by the second MANCOVA effect, a *Success due to Effort*-by-*Source of Control* interaction (Wilk's λ=.954, F=3.15, p=.05). Table H.2 also shows two significant follow-up contrasts, both on the adjusted *Recall Posttest*. The first finds that, for students in the *Program Control* group only, the Low block performed significantly better than the High block $t(133)$=3.90, p<.001 This matches the main effect mentioned previously. However, students in the *Program Control* group showed no such effect for the *Success due to Effort* blocking factor. The second significant contrast is between the *Program Control* and *Learner Control* groups, but only for the High *Success due to Effort* block $t(133)$=–2.08, p=.04. That is, while there is no significant difference between *Source of Control* groups in the Low block, there was such an effect for students in the High block, with the *Learner Control* group outperforming the *Program Control* group on the *Recall Posttest*. Figure 2 graphically illustrates this interaction effect.

Figure 2
Means for *Success due to Effort* -by-*Source of Control*



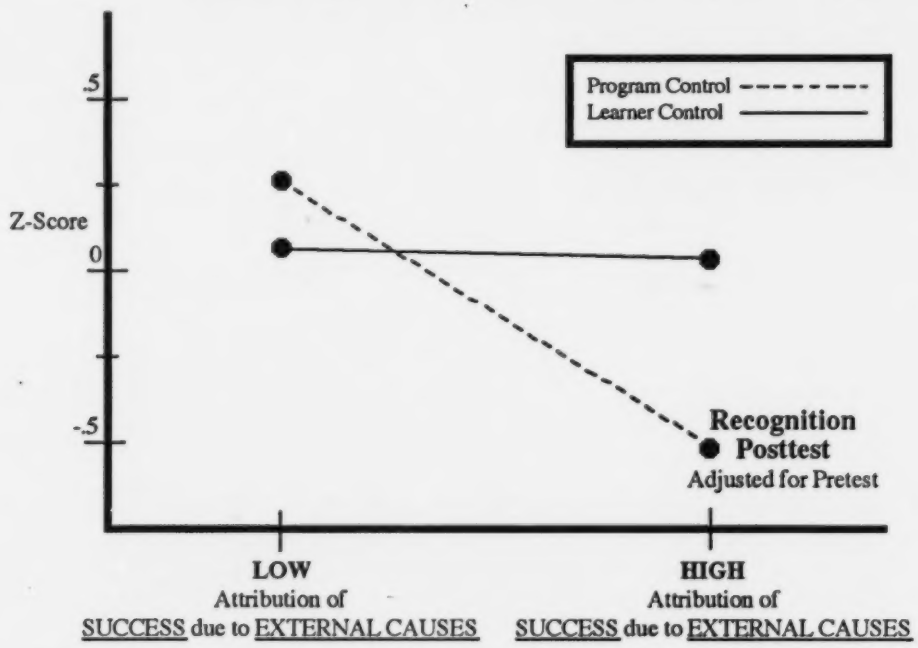
For Blocking Factor=*Success due to External Causes*. Three significant effects were found. The first was for the *Success due to External Causes* blocking factor alone (Wilk's λ=.938, F=4.37, p=.02). The follow-up test finds that the Low *Success due to External Causes* blocks had significantly better adjusted *Multiple-Choice Posttest* scores than the High block $t(133)$=3.90, p<.001. That is, students who tend to attribute their successes to external causes perform the worst on the *Multiple-Choice Posttest.* (Conversely, students who tend not to attribute their successes to external causes perform the best.) Figure 3 graphically illustrates this blocking factor effect.

Figure 3
Means for *Success due to External Causes*



The second multivariate effect was for the *Success due to External Causes*-by-*Source of Control* interaction (Wilk's λ=.941, F=4.13, p=.02). Two significant follow-up contrasts were found, the same as occurred in the analysis of the previous blocking factor, only for the adjusted *Multiple-Choice Posttest*, not the *Recall Posttest*. The first contrast finds that, for students in the *Program Control* group only, the Low block performed significantly better than the High block t(133)=3.91, p<.001. This matches the main effect mentioned previously. However, students in the *Program Control* group showed no such effect for the *Success due to External Causes* blocking factor. The second significant contrast is between the *Program Control* and *Learner Control* groups, but only for the High *Success due to Effort* block t(133)=–3.00, p=.003. That is, while there is no significant difference between *Source of Control* groups in the Low block, there was such an effect for students in the High block, with the *Learner Control* group outperforming the *Program Control* group on the *Multiple-Choice Posttest*. Figure 4 graphically illustrates this interaction effect.

Figure 4
Means for *Success due to External Causes*-by-*Source of Control*



The last of the multivariate effects for the *Success due to External Causes*-by-*Attributional Feedback* interaction (Wilk's λ=.947, F=3.67, p=.03). For students *WITHOUT Attributional Feedback*, the Low block performed better than the High block on both the adjusted *Multiple-Choice Posttest*, t(133)=3.51, p<.001, and on the *Recall Posttest*, t(133)=2.97, p=.004. Additionally, on the *Multiple-Choice Posttest* only, there was a significant contrast between both *Attributional Feedback* groups for the High block only, t(133)=–1.99, p=.05, those *WITH Attributional Feedback* outperforming those *WITHOUT Attributional Feedback*. Figures 5a (adjusted *Multiple-Choice Posttest*) and 5b (adjusted *Recall Posttest*) graphically illustrate this interaction effect.

Figure 5a
Means for *Success due to External Causes* -by-*Attributional Feedback*:

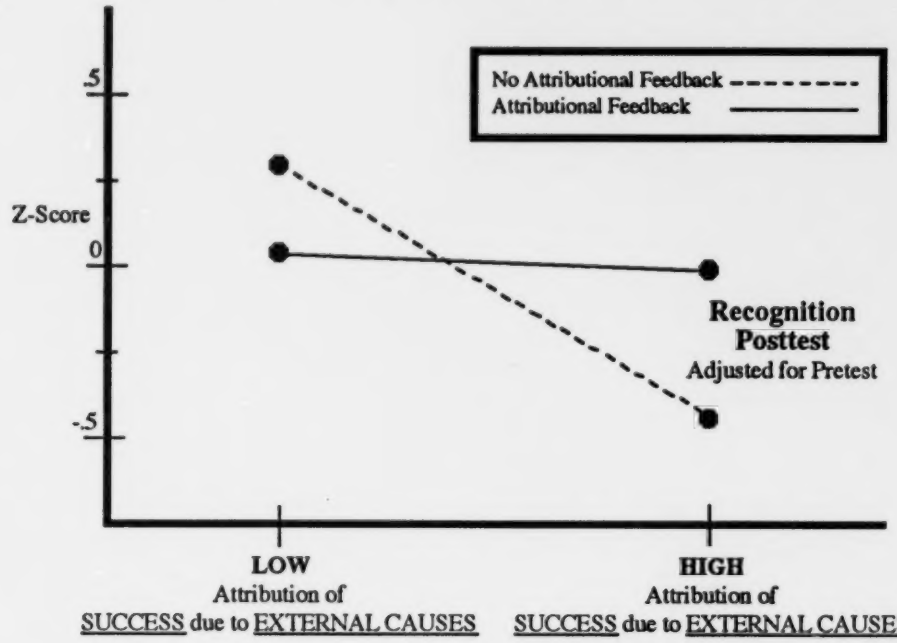
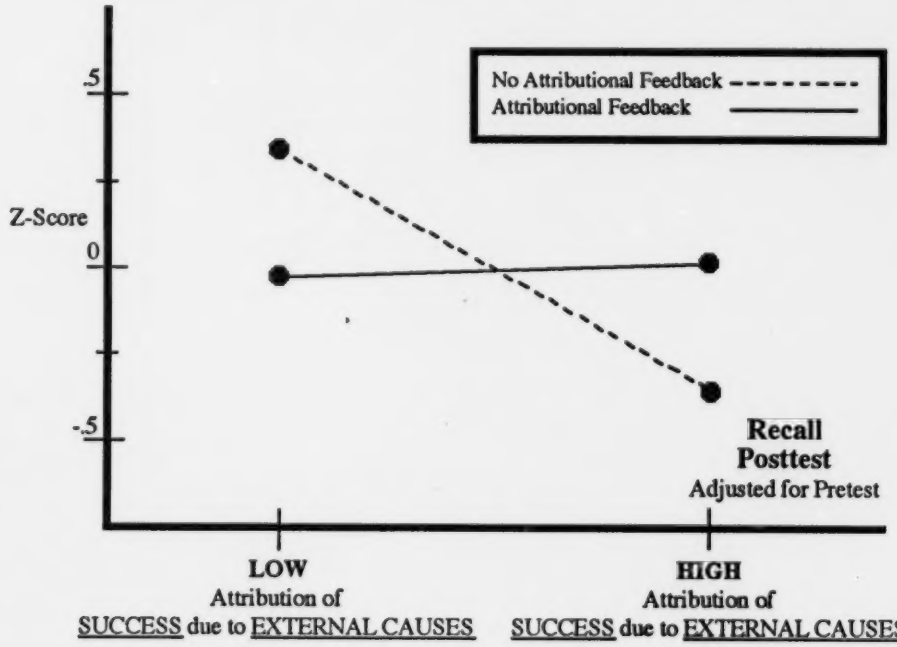
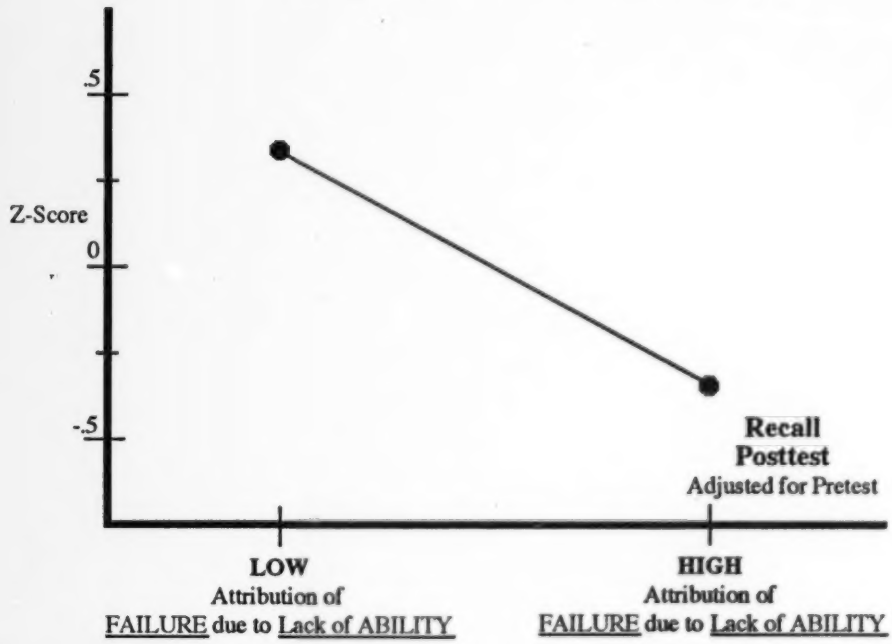


Figure 5b
Means for *Success due to External Causes* -by-*Attributional Feedback*:



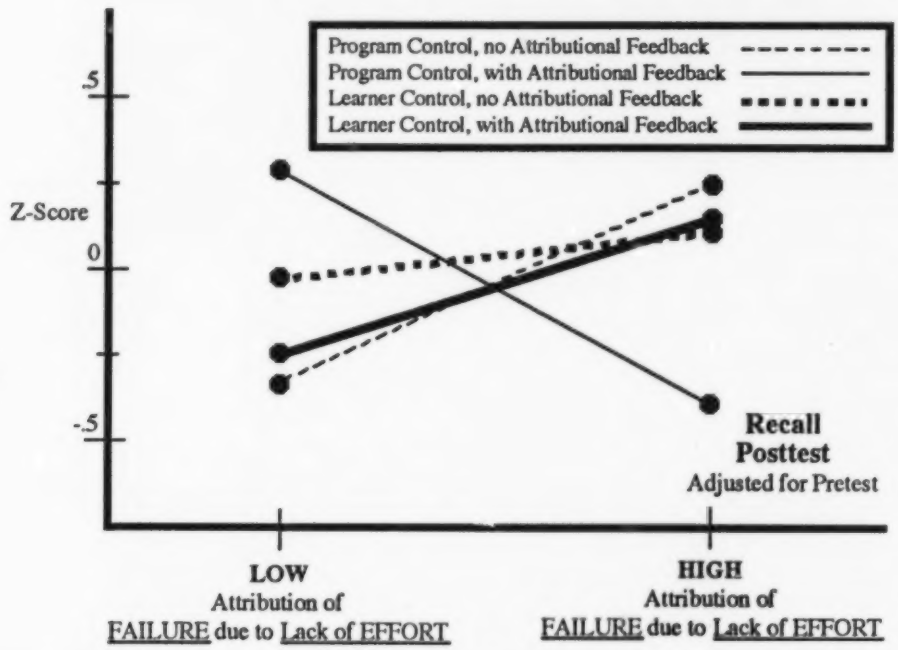
For Blocking Factor=*Failure due to Lack of Ability.* Only one significant effect was found: the *Failure due to Lack of Ability* blocking factor (Wilk's λ=.870, F=9.84, p<.001). The follow-up test finds that the Low *Failure due to Lack of Ability* block had significantly better adjusted *Recall Posttest* scores than the High block $t(133)$=4.45, p<.001. That is, students who tend to attribute their failures to their own lack of ability perform the worst. (Conversely, students who tend not to attribute their failures to their own lack of ability perform the best.) Figure 6 graphically illustrates this significant blocking factor effect.

Figure 6
Means for *Failure due to Lack of Ability* Blocks



For Blocking Factor=*Failure due to Lack of* Effort One other significant effect was found: the three-way interaction effect of *Failure due to Lack of Effort*-by-*Source of Control*-by-*Attributional Feedback* (Wilk's λ=.937, F=4.40, p<.01). This interaction occurs only for the adjusted *Recall Posttest* and is illustrated in Figure 7. In general, it can be seen that students in the *WITH Attributional Feedback* under *Program Control* treatment cell performed quite differently than students under the other three treatment combinations. Follow-up contrasts confirmed this relationship. First, there was a significant difference between block levels of *Failure due to Lack of Effort* in this treatment cell, t(133)=2.05, p=.04, with Low block students performing better than the High block students. Second, there was a significant difference in the between the two *Attributional Feedback* groups under *Program Control*, but differentially for each block. That is, for Low block students under *Program Control*, *WITH Attributional Feedback* was better than *WITHOUT Attributional Feedback*, t(133)=–1.99, p=.05, while for High block students *WITH Attributional Feedback* was worse than *WITHOUT Attributional Feedback*, t(133)=1.97, p=.05.

Figure 7
Means for *Failure due to Lack of Effort*
-by-*Source of Control*-by-*Attributional Feedback*



For Blocking Factor=*Failure due to External Causes*. No main effects or treatment interaction effects were significant.

Summary of Multivariate Analyses of Variance Table 6 presents a summary of the previous six MANCOVA's, specifying any significant multivariate effects.

Table 6
Summary of MANCOVA's for each Attributional Style Blocking Factor

	Attributional Style Blocking Factor:					
	Success due to:			*Failure due to:*		
Effect:	*Ability*	*Effort*	*External Causes*	*Lack of Ability*	*Lack of Effort*	*External Causes*
Covariate:						
Pretest	X^{ab}	X^{ab}	X^{ab}	X^{ab}	X^{ab}	X^{ab}
Treatments:						
Source of Control	-	-	-	-	-	-
Attributional Feedback	-	-	-	-	-	-
Source of Control -by-Attributional Feedback	-	-	-	-	-	-
Blocking Factor:						
Attributional Style	-	X^{b}	X^{a}	X^{b}	-	-
Attributional Style -by-Source of Control	-	X^{b}	X^{a}	-	-	-
Attributional Style -by-Attributional Feedback	-	-	X^{ab}	-	-	-
Attributional Style -by-Source of Control -by-Attributional Feedback	-	-	-	-	X^{b}	-

[a] = Significant for the *Multiple-Choice Posttest*
[b] = Significant for the *Recall Posttest*

Summary and discussion of the findings

Results As expected, there were no overall advantages for any version of the main experimental treatments. That is, all versions of *Source of Control* (program- and learner-controlled) and *Attributional Feedback* (with and without) were found to not be different in their effects on both multiple-choice and recall posttests.

Also as expected, scores on the pretest did not interact with either experimental treatment, but did show a significant positive main effect (i.e., pretest scores were correlated with both posttest scores).

The most interesting findings, and those connected with this study's research hypotheses, came from analyses of the effects of the attributional style blocking factors and their interactions with the experimental treatments

When taken independent of the experimental treatments, three of the *Attributional Style* blocking factors were found to be significantly and negatively related to posttest performance: *Success due to Effort*, *Failure due to Lack of Ability* (both on the recall posttest), and *Success due to External Causes*

(on the multiple-choice posttest). That is, students in the high blocks on each of these scales had the lowest posttest performance.

When examined in combination with the experimental treatments, other significant effects were found. Source of control (program- or learner-) was found to interact with both the *Success due to Effort* blocking factor (on the recall posttest), and the *Success due to External Causes* blocking factor (on the multiple-choice posttest) in the same way. That is, students under program-control exhibited the same pattern on posttest performance found for the main blocking effect alone, namely, high block students performed the poorest. However, under learner-controlled conditions there were no differences between low and high blocks. That is, learner-control seemed to mitigate the dysfunctional effects on performance which students in the high groups tended to exhibit under program-control.

A similar effect was found for the *Attributional Feedback* treatment in interaction with the *Success due to External Causes* blocking factor (on both the multiple-choice and the recall posttests). That is, students without attributional feedback showed the same pattern on posttest performance found in the main blocking factor effect, namely, students in the high block performed the worst. However, students provided with attributional feedback showed no differences between low and high blocks. Again, it seems that the experimental treatment of giving attributional feedback moderated the otherwise maladaptive tendencies of the high blocks.

Lastly was an interesting three-way interaction among both experimental treatments and the blocking factor of *Failure due to Lack of Effort* (on the recall posttest). The effects here were most pronounced when looking at the program-control treatment group only. Under this treatment condition, low block students with attributional feedback significantly outperformed students without feedback. For high block students, however, the reverse was true; that is, receiving such feedback significantly lowered their performance compared with those not receiving it. Students in the learner-control groups showed no such interaction, and appeared to all show a similar positive relationship between *Failure due to Lack of Effort* and learning. (Figure 4.7 clarifies this three-way interaction.)

Discussion The major purpose of this study was to investigate in a computer-based concept lesson the potential for attributionally related feedback to positively alter the temporary motivation for students who otherwise tend to exhibit maladaptive motivational patterns, and to improve learning as a consequence. On the basis of the study's findings, the intervention succeeded, at least for some maladaptive attributional styles. This discussion section presents interpretations of the results in three major areas: 1) the relationships between attributional styles and performance; 2) the impact of source of instructional control and of attributional feedback on performance for students with differing attributional styles; and 3) the relative impact of 1) and 2) on the two different posttests.

1. *Attributional styles and their connection with learning.* This study provides two overlapping sources of information which can be used to examine the connections between attributional styles and learning performance: first, the correlations among scores on the six original *ASQ* scales and the three tests (pretest and two posttests); second, main effects for the blocking factors included the MANCOVA's of the posttests.

The correlations show only one significant relationship between attributional style scales and performance, namely, that between the student's attributions of their own failures to their lack of ability and scores on the recall posttest. The relationship is negative indicating that students who tend to view their failures as due to lack of ability (for "ability," read: "*competence*") tend to perform the worst. This is consistent with correlations presented by Marsh (1984) and Greene (1985) who each found a similar negative relationship.

The effects of the attributional style blocking factors used in the MANCOVA's found that self-ratings of success as due to effort are *negatively* associated with performance on the recall posttest (a relationship hinted at, but non-significant in the correlation table mentioned in the previous paragraph). This finding is inconsistent with Marsh (1984) and Greene (1985) who found that ascriptions of success

to effort are not significantly related to any of the performance measures. However, these researchers looked at correlations between attributional styles and achievement without any intervening instruction. Perhaps the results found here are due to the unstable properties of effort attributions (Weiner, 1983). In fact, this is a desirable property which forms one of the premises of the current study, namely, that attributions can be temporarily altered with certain instructional manipulations.

Additionally from the MANCOVA's, students who tended to rate their successes to external factors were also found to also perform poorly on the multiple-choice posttest. This supports a similar conclusion from Bar-Tal (1978) and Stipek and Weisz (1981) about the dysfunctionality of such attributional patterns.

These findings generally support the notion that certain types of attributional styles are maladaptive, as defined by Dweck and Leggett (1988). That is, students who adopt such motivational patterns tend not to exert as much effort or mental investment in their learning activities, and thus tend to perform poorly. Some of the distinctions between these styles and their underlying constructs still need refining, but nevertheless, the current study supports the relevance of attributional styles to the learning process.

2. *Differential effects of instructional treatments*. In addition to confirming that attributional styles are important variables associated with learning, this study also set out to determine whether some type of instructional intervention might be able to modify a student's maladaptive motivational patterns, at least temporarily. In general, the study succeeded in improving the learning of students with some types of maladaptive attributional patterns. The granting of a relatively small degree of learner-control succeeded in improving the performance of students who otherwise showed poor motivational patterns, namely those who attribute their successes to either effort (effects found on the recall posttest) or to external causes (effects found on the multiple-choice posttest).

Additionally, attributionally related feedback was designed to encourage the student to ascribe their successes to their own competence and to attribute failures to lack of effort or to external causes. Indeed, for one attributional style at least, students who attributed their successes to external causes showed markedly improved performance on both posttests when given such feedback following their on-task performances.

Another interaction effect (for the recall posttest) was found between attributional feedback and the student's interpretation of their failures as due to lack of effort. For most of the students, there seemed to be the typical relationship found by several other researchers, namely, that students who tended to make such attributions performed the least and those who did not rate their failures as being due to lack of effort performed the worst. However, at least for students under program-control, the inclusion of attributional feedback had the effect of inverting this relationship. That is, not only did attributional feedback succeed in improving scores for those who had maladaptive attributions on this scale, but such feedback seemed to have a deleterious effect on those who otherwise had a functional attributional pattern. Of course, it remains to be seen whether such a complex interaction is replicated in other studies.

These two instructional interventions has the result of actually eliminating the differences between the high and low groups on the relevant attributional styles. That is, students who had adopted some type of maladaptive pattern and received the treatments mentioned above showed improvement in their learning so to actually match that of those who exhibited adaptive patterns.

3. *Effects on the different posttests.* The multiple-choice posttest and the recall posttest can be said to measure different types or depths learning. That is, the multiple-choice posttest, by virtue of the fact that students are asked to select from a list containing the correct answer, represents a different kind of memory process than the recall posttest which requires the student to produce the answer from memory without the aid of visual cues.

It is difficult to discern any obvious patterns among the above treatment effects and these types of learning outcomes. Generally, though, it seems that the treatment effects interacting with the internal attributional styles of ability or effort seem to be confined to the recall posttest, while the effects found for the external attributional styles are mostly limited to the multiple-choice posttest. It is not clear from this study why this distinction should exist. Perhaps, attributional patterns are more generally associated with certain types of learning, or perhaps the instructional interventions differentially tapped different kinds of memory processes.

Discussion of the Results and Implications This study brings together two bodies of research which have been hitherto largely been treated separately: learner-control of computer-based instruction and attribution theory. That is, with the exception of one early study (Fisher et al., 1975) no studies uncovered in a literature search for this paper have explicitly examined the relationships between student attributions and performance within learner-controlled environments.

One of the starting points of this paper was that learner-control of instruction is differentially successful for learners with different motivation levels. The current study supports this idea and finds that learner-control can help some students with dysfunctional motivational patterns to improve their learning. The implications of the findings from the current study seem to fall into two major areas, possible explanations for some of the previously inconsistent and disappointing research findings on learner-controlled instruction, and suggestions for instructional prescriptions based on attributional information gathered from students.

First, certain attributional styles of students seem able to at least partially explain the mixed successes of learner-controlled instruction in the past. That is, the current study found that some students do not perform well under program control of practice retries, and seem to require a measure of learner-control of this instructional activity to do as well as everyone else.

Second, this study also offers one means by which otherwise maladaptive students can be influenced to alter their on-task self-perceptions, and thus, to increase the effort they expend during the lesson. Although the mechanisms for these effects of attributional feedback are not entirely clear, it is suggested that giving students with maladaptive attributional patterns a small degree of control of their instruction can help improve feelings of self-efficacy (Bandura, 1982; Schunk, 1984), and contribute to a greater mental investment (Salomon, 1983).

The findings from this study also support the inclusion of attributions as a variable from which to adapt instruction. It also shows that, at least to a degree, the attributional feedback approaches of Schunk (1982, 1983, 1990a) will, with care, transfer to a computer-delivered format. It is, of course, not suggested that nothing is lost when the computer provides the feedback to the learner in comparison to teacher-delivered feedback; but apparently for some types of feedback and in some types of instructional situations, the computer can provide the learner with sufficient encouragement or reflection to temporarily alter the mental effort exhibited.

This use of attributional feedback supports the motivational design model of Keller (1987a, 1987b). That is, with a careful design, we can succeed in improving the motivational patterns of some otherwise maladaptive students. In particular, the approach adopted here provides sustenance for Keller's recommendations for improving student *Confidence*. That is, judiciously applied attributional feedback has the capability of altering, even if temporarily, certain student's on-task motivation.

In addition, this study supports the adaptive instruction paradigm of Gehlbach (1979). In this framework, unlike the classic ATI approach of Cronbach (1957, 1975), students who are deficient in some relevant aptitude are administered an instructional treatment intended to "correct" the difficulty, not accommodate it. In the current case, students who have suboptimal attributional styles are provided with corrective feedback in an attempt to realign their momentary perceptions of their performances.

References

Anderson, R.C. (1972). How to construct achievement tests to assess comprehension. *Review of Educational Research, 42*(2), 145-170.

Andrews, G.R., & Debus, R.L. (1978). Persistence and the causal perception of failure: modifying cognitive attributions. *Journal of Educational Psychology, 70*(2), 154-166.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist, 37*(2), 122-147.

Bar-Tal, D. (1978). Attributional analysis of achievement-related behavior. *Review of Educational Research, 48*(2), 259-271.

Bar-Tal, D., Raviv, A., Raviv, A., & Bar-Tal, Y. (1982). Consistency of pupils' attributions regarding success and failure. *Journal of Educational Psychology, 74*(1), 104-110.

Bray, S.E., & Maxwell, J.H. (1985). *Multivariate analysis of variance.* Beverly Hills, CA: Sage.

Brophy, J. (1983). Conceptualizing student motivation. *Educational Psychologist, 18*(3), 200-215.

Carrier, C.A. (1984). Do learners make good choices? A review of research on learner control in instruction. *Instructional Innovator, 29*(2), 15-17.

Carrier, C.A., & Williams, M.D. (1988). A test of one learner-control strategy with students of differing levels of task persistence. *American Educational Research Journal, 25*(2), 285-306.

Cronbach, L.J. (1957). The two disciplines of scientific psychology. *American Psychologist, 12*(11), 671-684.

Cronbach, L.J. (1975). Beyond the two disciplines of scientific psychology. *American Psychologist, 30*(2), 116-127.

Cronbach, L.J., Gleser, G.C., Nanda, H., & Rajaratnam, N. (1972). *The dependability of behavioral measurements: Theory of generalizability for scores and profiles.* New York: John Wiley.

Cronbach, L.J., & Snow, R.E. (1977). *Aptitudes and instructional methods.* New York: Irvington.

Dweck, C.S. (1975). The role of expectations and attributions in the alleviation of learned helplessness. *Journal of Personality and Social Psychology, 31*(4), 674-685.

Dweck, C.S., & Leggett, E.L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review, 95*(2), 256-273.

Ehman, L.H., & Glenn, A.D. (1987). *Computer-based education in the social studies.* Bloomington, IN: Social Studies Development Center, Indiana University. (ERIC Document Reproduction Service No. ED 284-825)

Elig, T.W., & Frieze, I.H. (1979). Measuring causal attributions for success and failure. *Journal of Personality and Social Psychology, 37*(4), 621-634.

Fisher, M.D., Blackwell, L.R., Garcia, A.B., & Greene, J.C. (1975). Effects of student control and choice on engagement in a CAI arithmetic task in a low-income school. *Journal of Educational Psychology, 67*(6), 776-783.

Fowler, J.W., & Peterson, P.L. (1981). Increasing reading persistence and altering attribution style of learned helpless children. *Journal of Educational Psychology, 73*(2), 251-260.

Gagné, R.M. (1985). *Conditions of learning* (4th ed.). New York: Holt, Rinehart & Winston.

Gagné, R.M., Briggs, L.J., & Wager, W.W. (1988). *Principles of instructional design* (3rd ed.). New York: Holt, Rinehart & Winston.

Gehlbach, R.D. (1979). Individual differences: Implications for instructional theory, research, and innovation. *Educational Researcher, 8*(4), 8-14.

Greene, J.C. (1985). Relationships among learning and attribution theory motivational variables. *American Educational Research Journal, 22*(1), 65-78.

Hannafin, M.J. (1984). Guidelines for using locus of instructional control in the design of computer-assisted instruction. *Journal of Instructional Development, 7*(3), 6-10.

Hurlock, R.E., Lahey, G.F., & McCann, P.H. (1974). *Student-controlled versus program controlled CAI.* San Deigo, CA: Naval Personnel Research and Development Center. (ERIC Document Reproduction Service No. ED 089 681)

Johansen, K.J., & Tennyson, R.D. (1983). Effect of adaptive advisement on perception in learner controlled, computer-based instruction using a rule-learning task. *Educational Communications and Technology Journal*, *31*(4), 226-236.

Keller, J.M. (1987a). Strategies for stimulating the motivation to learn. *Performance & Instruction*, *26*(8), 1-7.

Keller, J.M. (1987b). The systematic process of motivational design. *Performance & Instruction*, *26*(9-10), 1-8.

Kirk, R.E. (1982). *Experimental design: Procedures for the behavioral sciences*. Belmont, CA: Brooks/Cole.

Kukla, A. (1978). An attributional theory of choice. In L. Berkowitz (Ed.), *Advances in experimental social psychology: Vol. 11* (pp. 113-144). New York: Academic Press, Inc.

Lord, F.M., & Novick, M.R. (1968). *Statistical Theories of Mental Test Scores*. Reading, MA: Addison-Wesley.

Lovell, M.C. (1987). CAI on PCs–Some economic applications. *Journal of Economic Education*, *18*(3), 319-329.

Marsh, H.W. (1983). *Relationships among dimensions of self-attribution, dimensions of self-concept and academic achievements*. (ERIC Document Reproduction Service No. ED 243 914)

Marsh, H.W. (1984). Relations among dimensions of self-attribution, dimensions of self-concept, and academic achievements. *Journal of Educational Psychology*, *76*(6), 1291-1308.

Marsh, H.W., Cairns, L., Relich, J., Barnes, J., & Debus, R.L. (1984). The relationship between dimensions of self-attribution and dimensions of self-concept. *Journal of Educational Psychology*, *76*(1), 3-32.

Maruyama, G. (1982). How should attributions be measured? A reanalysis of data from Elig and Frieze. *American Educational Research Journal*, *19*(4), 552-558.

Medway, F.J., & Venino, G.R. (1982). The effects of effort feedback and performance patterns on children's attributions and task persistence. *Contemporary Educational Psychology*, *7*(1), 26-34.

Merrill, M.D. (1983). Component display theory. In C.M. Reigeluth (Ed.), *Instructional-design theories and models* (pp. 279-334). Hillsdale, NJ: Lawrence Erlbaum.

Merrill, M.D. (1987). The new component design theory: Instructional design for courseware authoring. *Instructional Science*, *16*(1), 19-34

Milheim, W.D., & Martin, B.L. (1991). Theoretical bases for the use of learner control: Three different perspectives. *Journal of Computer-Based Instruction*, *18*(3), 99-105.

Penland, P. (1979). Self-initiated learning. *Adult Education*, *29*(3), 170-179.

Reigeluth, C.M., & Stein, F.S. (1983). The elaboration theory of instruction. In C.M. Reigeluth (Ed.), *Instructional-design theories and models* (pp. 335-382). Hillsdale, NJ: Lawrence Erlbaum.

Ross, S.M., & Rakow, E.A. (1981). Learner control versus program control as adaptive strategies for selection of instructional support on math rules. *Journal of Educational Psychology*, *73*(5), 745-753.

Rotter, J.B. (1966). Generalized expectancies for internal versus external control of reinforcement. *Psychological Monographs*, *1* (whole no. 609).

Rummel, R.J. (1970). *Applied factor analysis*. Evanston, IL: Northwestern University Press.

Sales, G.C., & Williams, M.D. (1988). The effect of adaptive control of feedback in computer-based instruction. *Journal of Research on Computing in Education*, *21*(1), 97-111.

Salomon, G. (1983). The differential investment of mental effort in learning from different sources. *Educational Psychologist*, *18*(1), 42-50.

Schunk, D.H. (1982). Effects of effort attributional feedback on children's perceived self-efficacy and achievement. *Journal of Educational Psychology*, *74*(4), 548-556.

Schunk, D.H. (1983). Ability versus effort attributional feedback: Differential effects on self-efficacy and achievement. *Journal of Educational Psychology*, *75*(6), 848-856.

Schunk, D.H. (1984). Self-efficacy perspective on achievement behavior. *Educational Psychologist*, *19*(1), 48-58.

Schunk, D.H. (1990a, April). *Socialization and the development of self-regulated learning: The role of attributions*. Paper presented at the annual meeting of the American Educational Research Association, Boston, MA. (ERIC Document Reproduction Service No. ED 317 581)

Seidel, R.J., Wagner, H., Rosenblatt, R.D., Hillelsohn, M.J., & Stelzer, J. (1975). *Learner control of instructional sequencing within an adaptive tutorial CAI environment* (Report No. HumRRO-TR-75-7). Alexandria, VA: Human Resources Research Organization. (ERIC Document Reproduction Service No. ED 111 338)

Snow, R.E. (1979, April). *Aptitude, learner control, and adaptive instruction.* Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA. (ERIC Document Reproduction Service No. ED 180 447)

Snow, R.E. (1980). Aptitude, learner control, and adaptive instruction. *Educational Psychologist*, *15*(3), 151-158.

Steinberg, E.R. (1977). Review of student control in computer-assisted instruction. *Journal of Computer-Based Instruction*, *3*(3), 84-90.

Steinberg, E.R. (1984). *Teaching computers to teach.* Hillsdale, NJ: Lawrence Erlbaum.

Steinberg, E.R. (1989). Cognition and learner control: A literature review, 1977-1988. *Journal of Computer-Based Instruction*, *16*(4), 117-124.

Stipek, D.J., & Weisz, J.R. (1981). Perceived personal control and academic achievement. *Review of Educational Research*, *51*(1), 101-137.

Tennyson, R.D. (1981). Use of adaptive information for advisement in learning concepts and rules using computer-assisted instruction. *American Educational Research Journal*, *18*(4), 425-438.

Tennyson, R.D., & Buttrey, T. (1980). Advisement and management strategies as design variables in computer-assisted instruction. *Educational Communications and Technology Journal*, *28*(3), 169-176.

Timm, N.H. (1975). *Multivariate anslysis with applications in education and psychology.* Monterey, CA: Brooks/Cole.

Tobias, S. (1987). Mandatory text review and interaction with student characteristics. *Journal of Educational Psychology*, *79*(2), 154-161.

Wainer, H. (1986). Can a test be too reliable? *Journal of Educational Measurement*, *23*(2), 171-173.

Weiner, B. (1974). An attributional interpretation of expectancy-value theory. In B. Weiser (Ed.), *Cognitive views of human motivation* (pp. 51-69). New York: Academic Press, Inc.

Weiner, B. (1983). Some methodological pitfalls in attributional research. *Journal of Educational Psychology*, *75*(4), 530-543.

Williams, M.D. (1989, February). *Motivational Feedback and Learner-Controlled CBI.* In Carrier, C.A. (Chair), Feedback and motivation in the design of computer-based instruction. Symposium conducted at the AECT Conference, Dallas, TX.